전공의 연수교육

흉벽질환, 다한증, 흉곽출구증후군

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이성수

Chest Wall Deformity

Deformities of the anterior chest wall are widely recognized,

poorly understood and

generally neglected.

- *Charles W. Lester*

Pectus Excavatum

- ***Funnel chest*** is an **oval depression** which involves the **sternum** as well as the **costal cartilages**.

- Usually it is already evident **in infancy**, and it becomes more marked as the child reaches maturity.

- The degree of the deformity varies from a mild depression on the sterno-xiphoid angle, to a severe ″cave-in″ of most of the anterior chest wall with the lower sternum touching the vertebral column.

- Pectus excavatum is a relatively common anomaly
  - occurs in about one in 300–400 live births
  - three times more frequent in males
  - often associated with connective tissue disorders, such as Marfan's disease or Ehlers-Danlos syndrome

- Symptoms
  - palpitation, exertional dyspnea, fatigue and dull precordial pain, paradoxical breathing, exercise intolerance

- The deformity is also often emotionally disturbing, especially in adolescents, who often avoid active sports and become shy and retiring.

Etiology

- heredity :about 20 to 50% of patients have a family history of pectus deformities - Williams 1872
- an overgrowth of the costal cartilages – Flesch 1873
- arrested growth of the sternum - Ebstein 1882
- various intrauterine compressive forces such as pressure by the chin, knee or elbow
- latent mediastinitis – Raubitsch
- undue traction exerted upon the sternum by the diaphragmatico-sternal ligament - Lincoln Brown 1939(1596)

Repair of PE

- Initially surgical intervention
  - only for patients with severe sternal depression
  - aimed primarily at relieving cardiac compression
  - cosmesis played a secondary role

- Deformed chest
  - a potential source of embarrassment
  - especially during adolescence and in young adulthood
  - operative correction is now recommended by most practitioners even in the absence of other symptoms

- Earlier operations - easy to perform, better results
  - at a later age :chest is less pliable and less accommodating

Historical period

- The first surgical intervention of pectus excavatum
  - Wilhelm Meyer in 1911
  - resected right 2nd and 3rd costal cartilages
  - significantly improved dyspnea

- Sauerbruch performed a more radical procedure in 1913
  - 5th to 9th costal cartilage, left hemisternum

- Judet in 1954 performed a sternal turn-over procedure
  - reattaching the resected sternochondral apron in the anterior chest wall

The modern era

- less than satisfactory late outcomes
- corrected position of the sternum using substernal support

- The principles of modern pectus excavatum surgery
  - Ravitch in 1949.

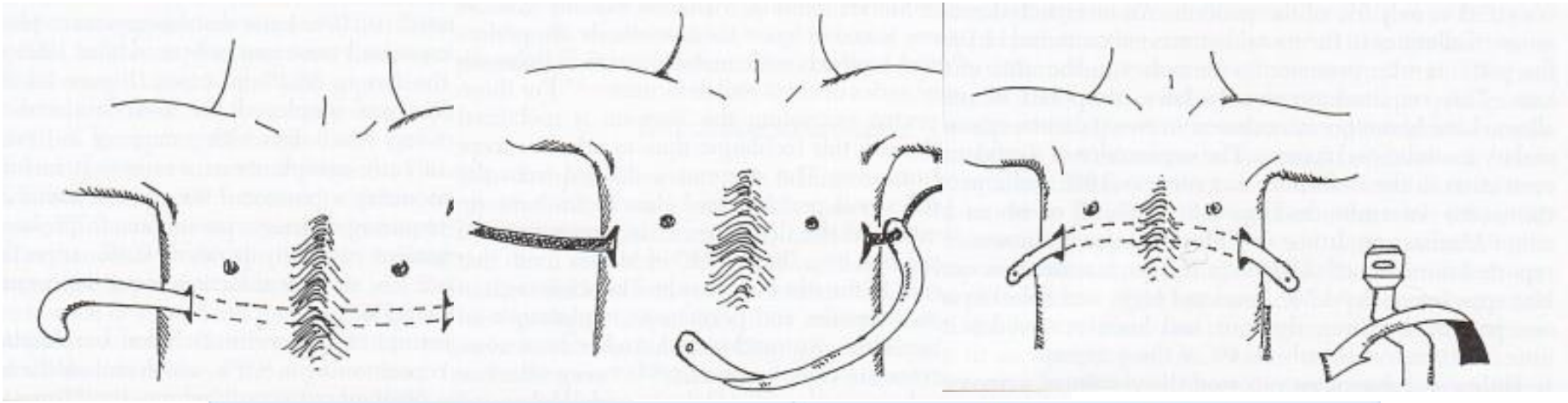
  (a) the removal of deformed cartilages,
  (b) division of the xiphisternal articulation,
  (c) transverse cuneiform osteotomy of the sternum at the upper level of the deformity
  (d) maintenance of the corrected position of the sternum

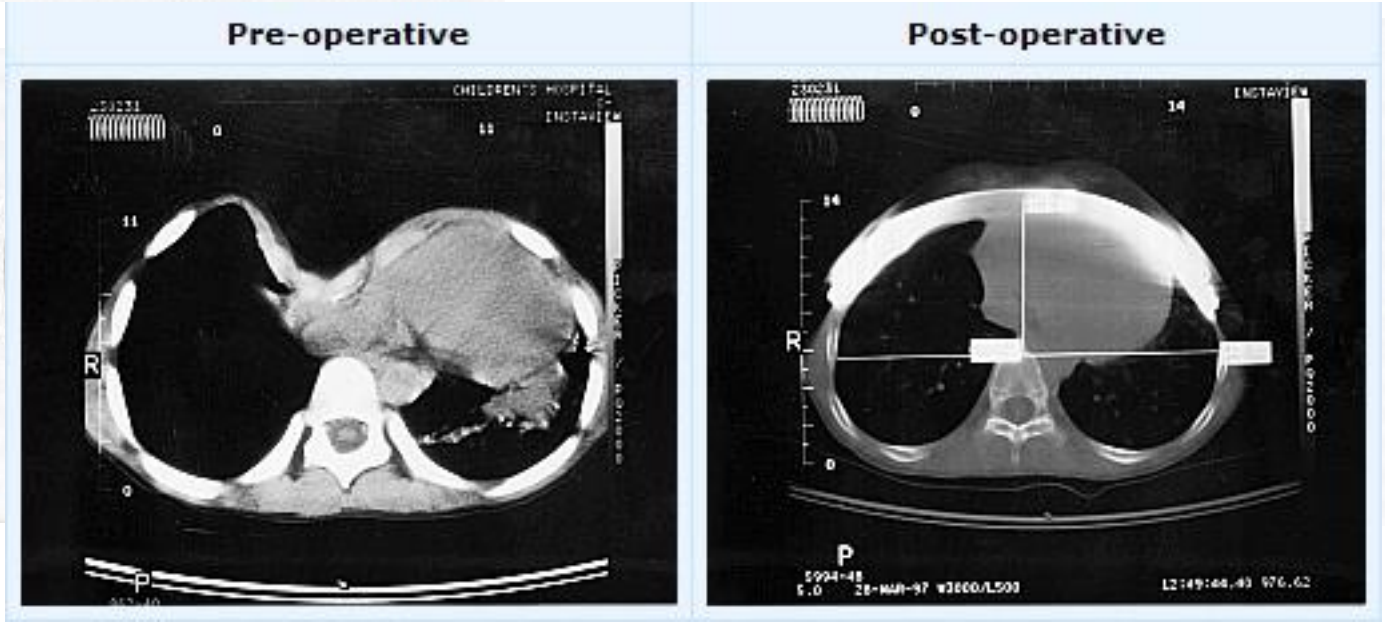
New Pectus Excavatum Surgery

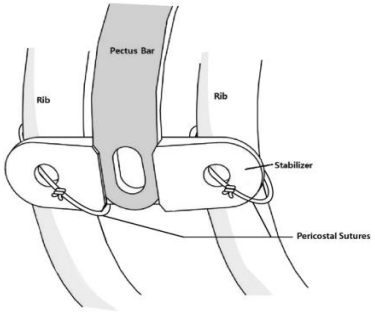
- ″minimally invasive repair of pectus excavatum″ by Donald Nuss in 1998

- the number of patients operated for pectus excavatum has more than tripled in the last few years

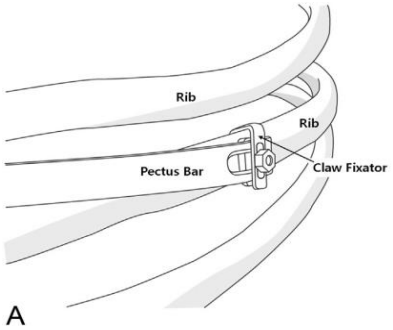
Nuss procedure



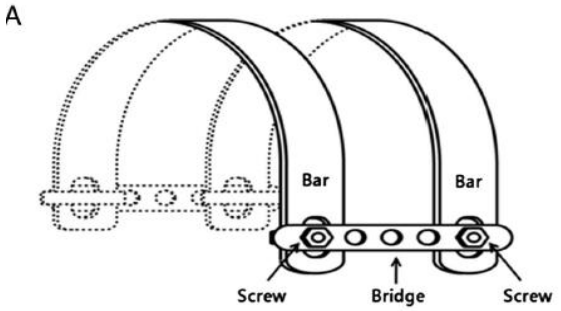




Stabilizer



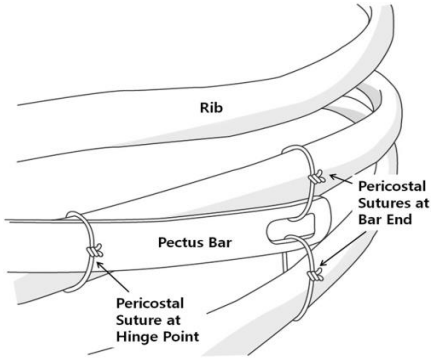
Claw fixation



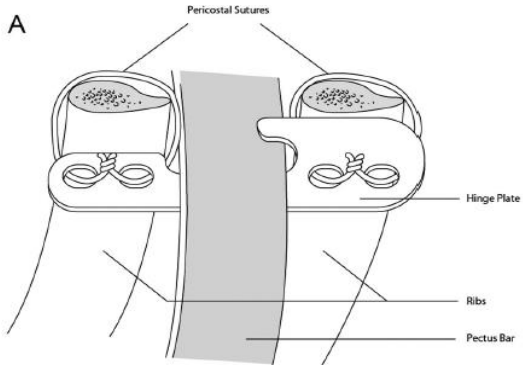
Bridge technique

1999 2001 2007 2009 2013

MPF



Hinge plate



Vaccum Bell

- Klobe's suction cup for pectus excavatum:

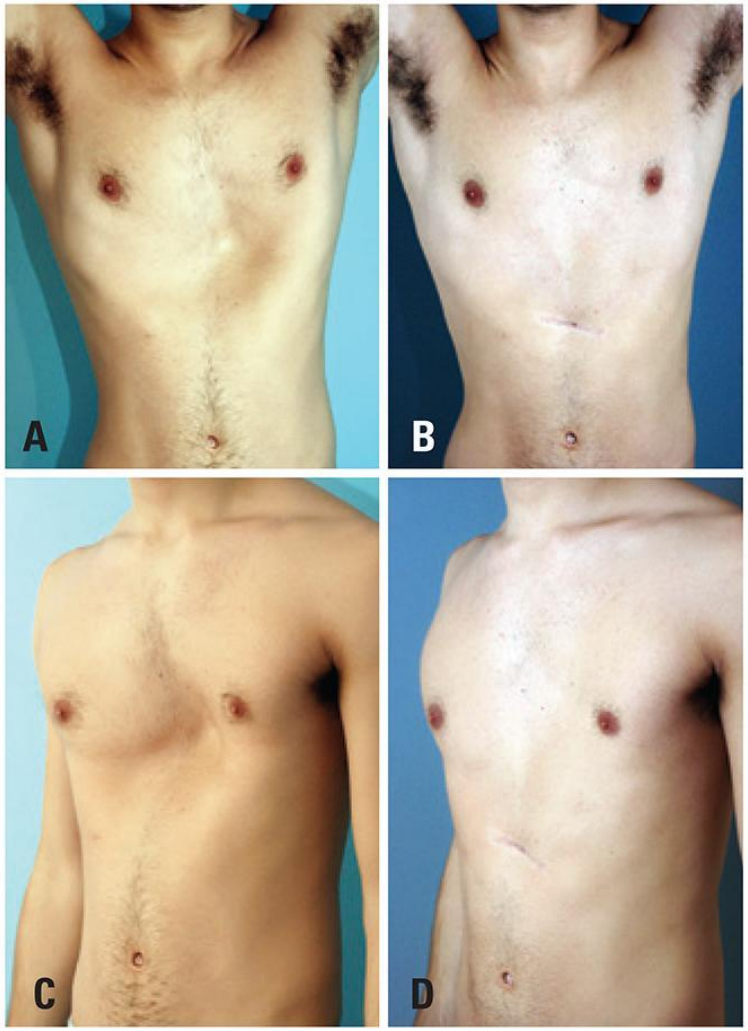
"If the chest can be pushed out, can it be pulled out"

Magnetic Mini Mover Procedure (3MP)

- uses two magnets to slowly reconfigure the child's chest, similar in concept to orthodontics.
- By adjusting the external magnet (Magnatrac), the internal magnet (Magnimplant) can slowly reconfigure the chest

Silastic molds

- Allen and Douglas implanted Silastic molds into the subcutaneous space to fill the depression in pectus excavatum



Pectus Carinatum

- Pectus carinatum is 16.7% of all chest wall deformities in the Boston children's hospital experience.

- Chondrogladiolar type : most frequent form
  - anterior protrusion of the body of the sternum
  - protrusion of the lower costal cartilages

- Chondromanubrial or "pouter pigeon" deformity
  : least frequent form
  - protrusion of the upper costal cartilages
  - relative depression of the body of the sternum.

Pectus Carinatum

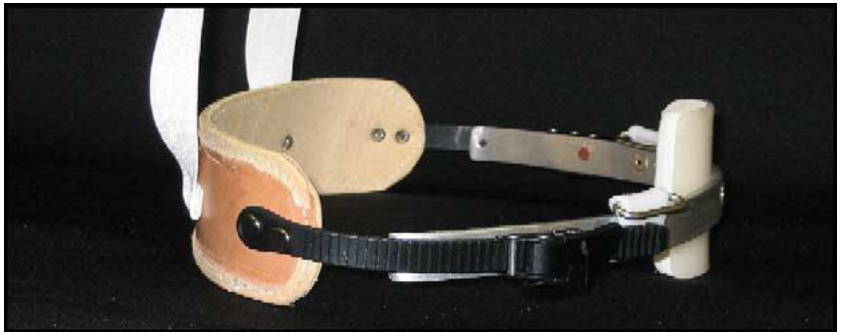
- Etiology : not clear
  - an overgrowth of the costal catilages with forward buckling of the cartilages and anterior displacement of the sternum
  - genetic basis : 26% had a family history of chest wall deformity and 12% of scoliosis.
  - more frequent in boys than in girls - 3:1

- PC is rarely present at birth
  - deformity was not identified until after the eleventh birthday
  - deformity often progresses during early childhood
    particularly in the period of rapid growth at puberty.

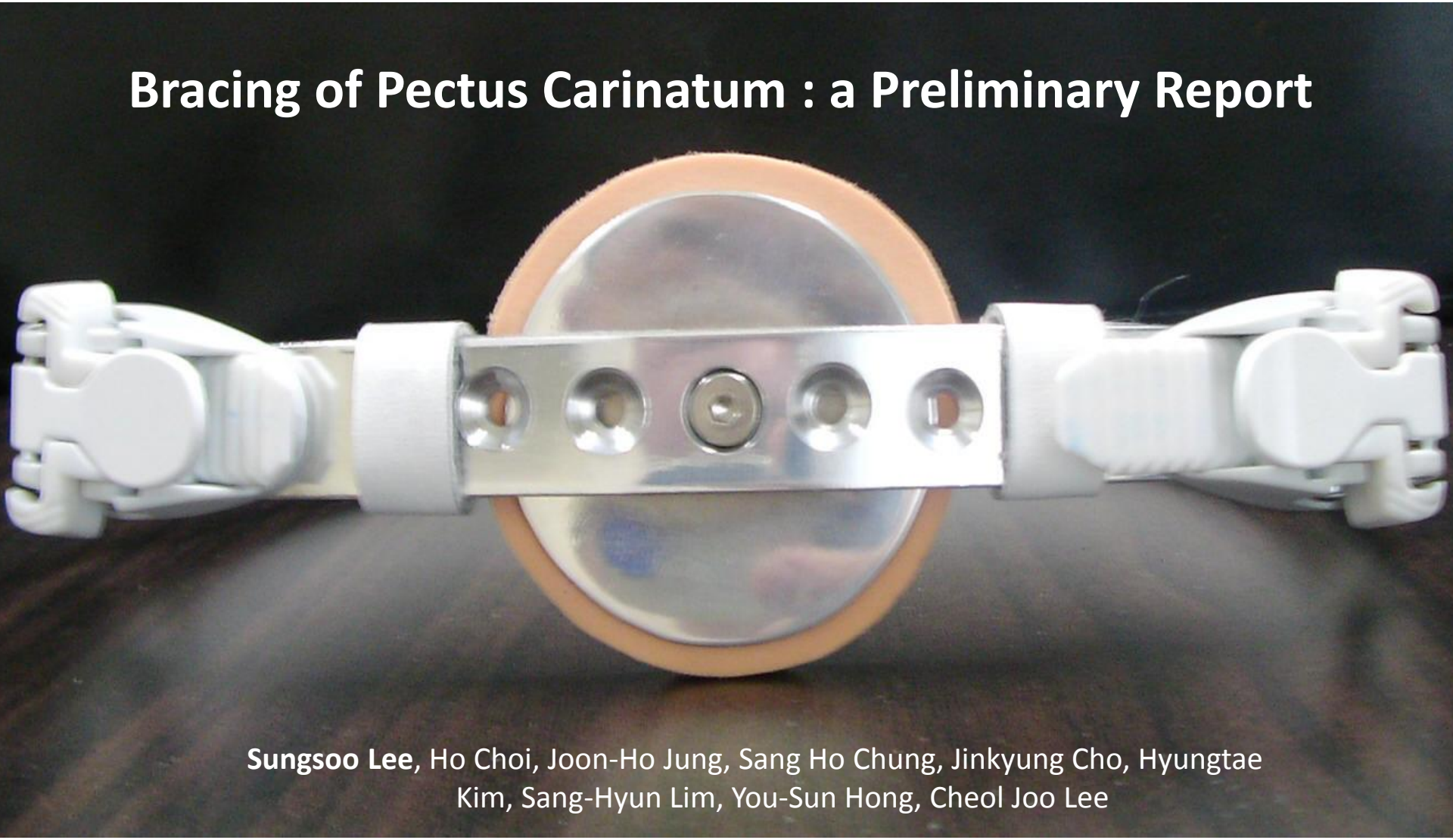
Surgical repair

- The current correction of Pectus Carinatum is surgical, often involving resection of costal cartilages and sternal osteotomy and recently there are minimally invasive modifications using thoracoscope.
- The majority of these operations are variations of the procedure first described in 1949 by Ravitch.

Compressive bracing for Pectus carinatum



Bracing of Pectus Carinatum : a Preliminary Report



Sungsoo Lee, Ho Choi, Joon-Ho Jung, Sang Ho Chung, Jinkyung Cho, Hyungtae Kim, Sang-Hyun Lim, You-Sun Hong, Cheol Joo Lee

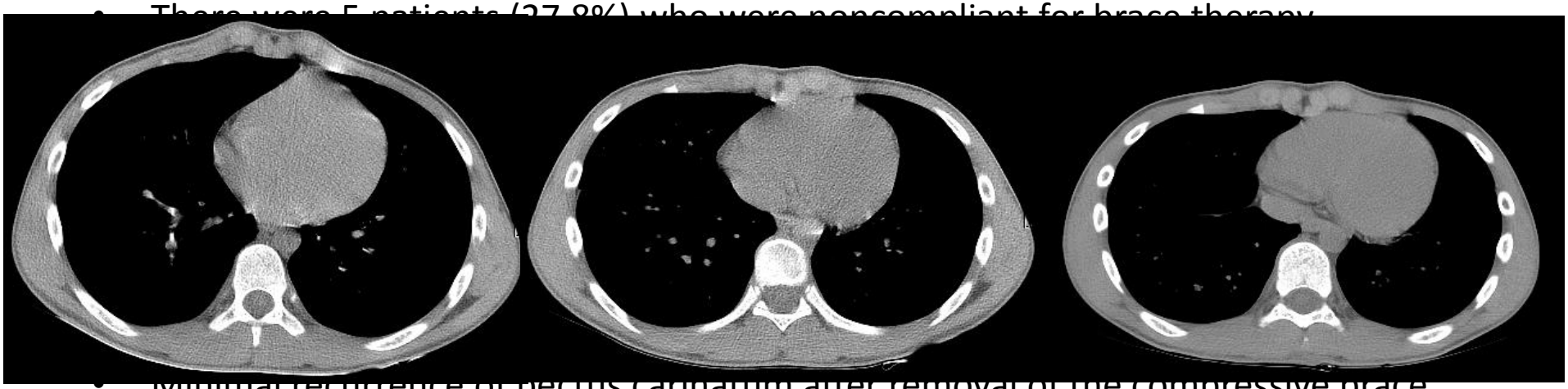

SEODO
DONGDO
DOKDO BELONGS TO KORA


EASTERN
LEAGUE
Baseball
E.junior

Results

- 13 (72.2%) patients have completed treatment (mean bracing time, 4.9 ± 1.4 months).

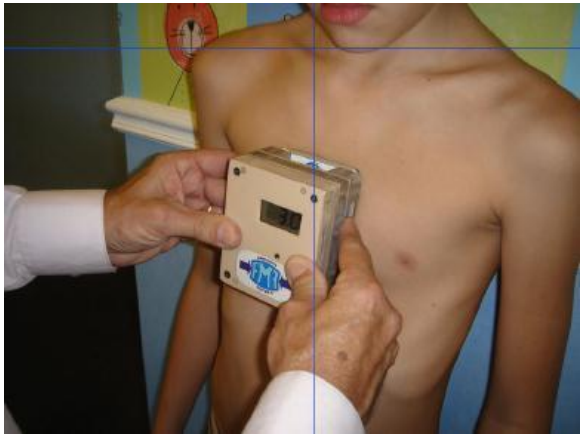
- There were 5 patients (27.8%) who were noncompliant for brace therapy

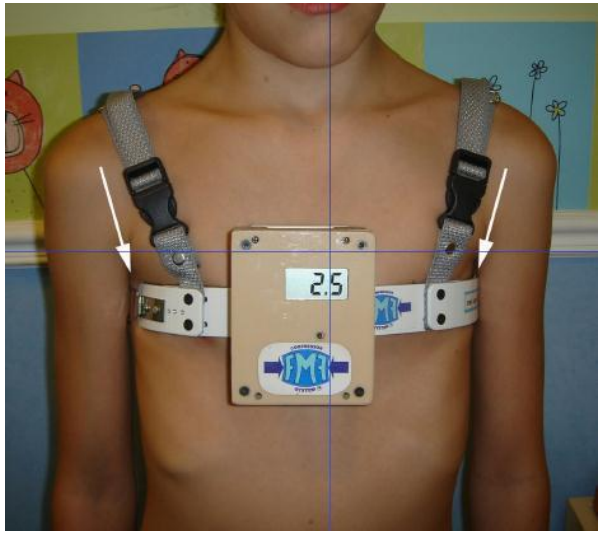


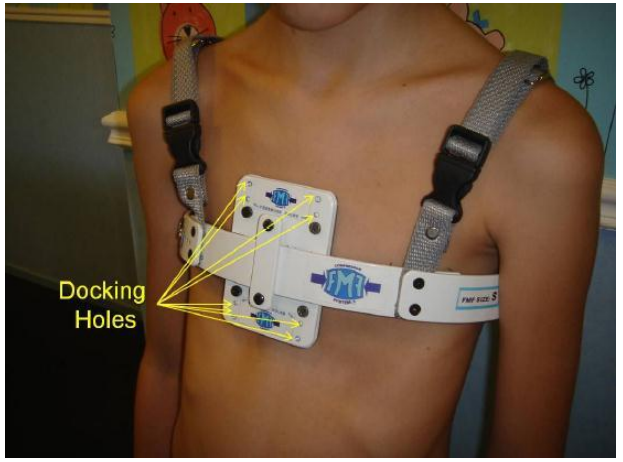
- Minimal recurrence of pectus carinatum after removal of the compressive brace occurred in 5 (38.5%) of 13 patients.

- All these patients stopped wearing the compressive brace in 4 months against our advice.

New brace



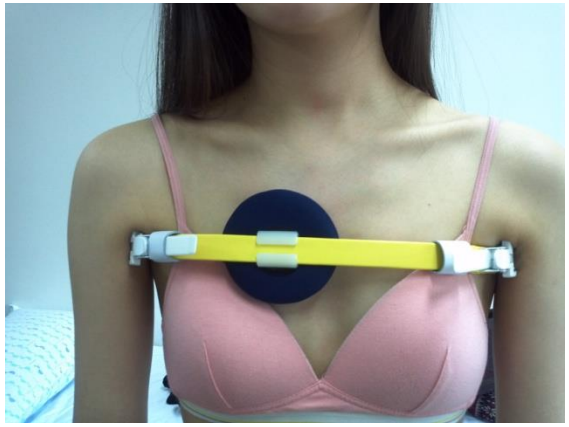
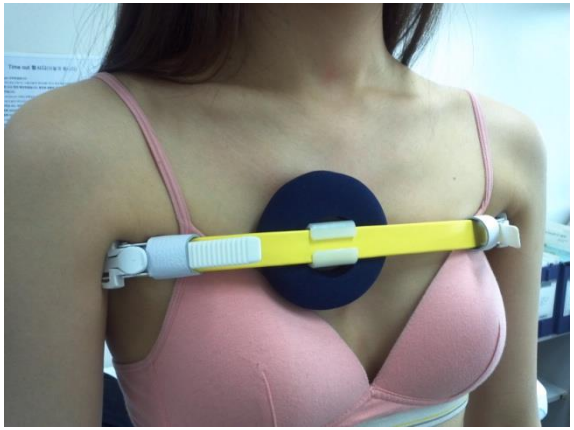
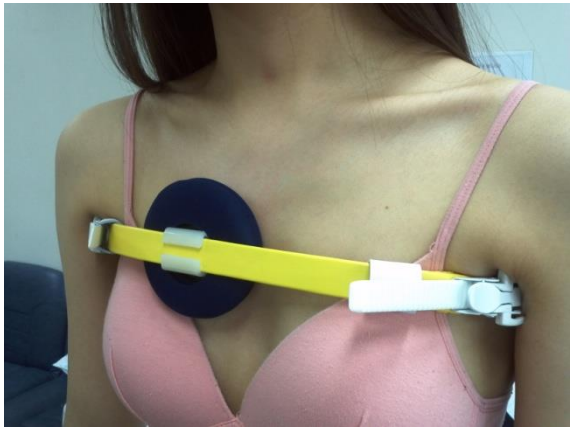




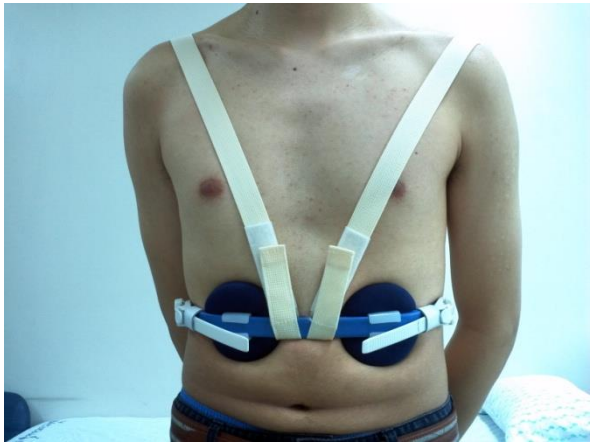
Overcorrection

Atypical lesion

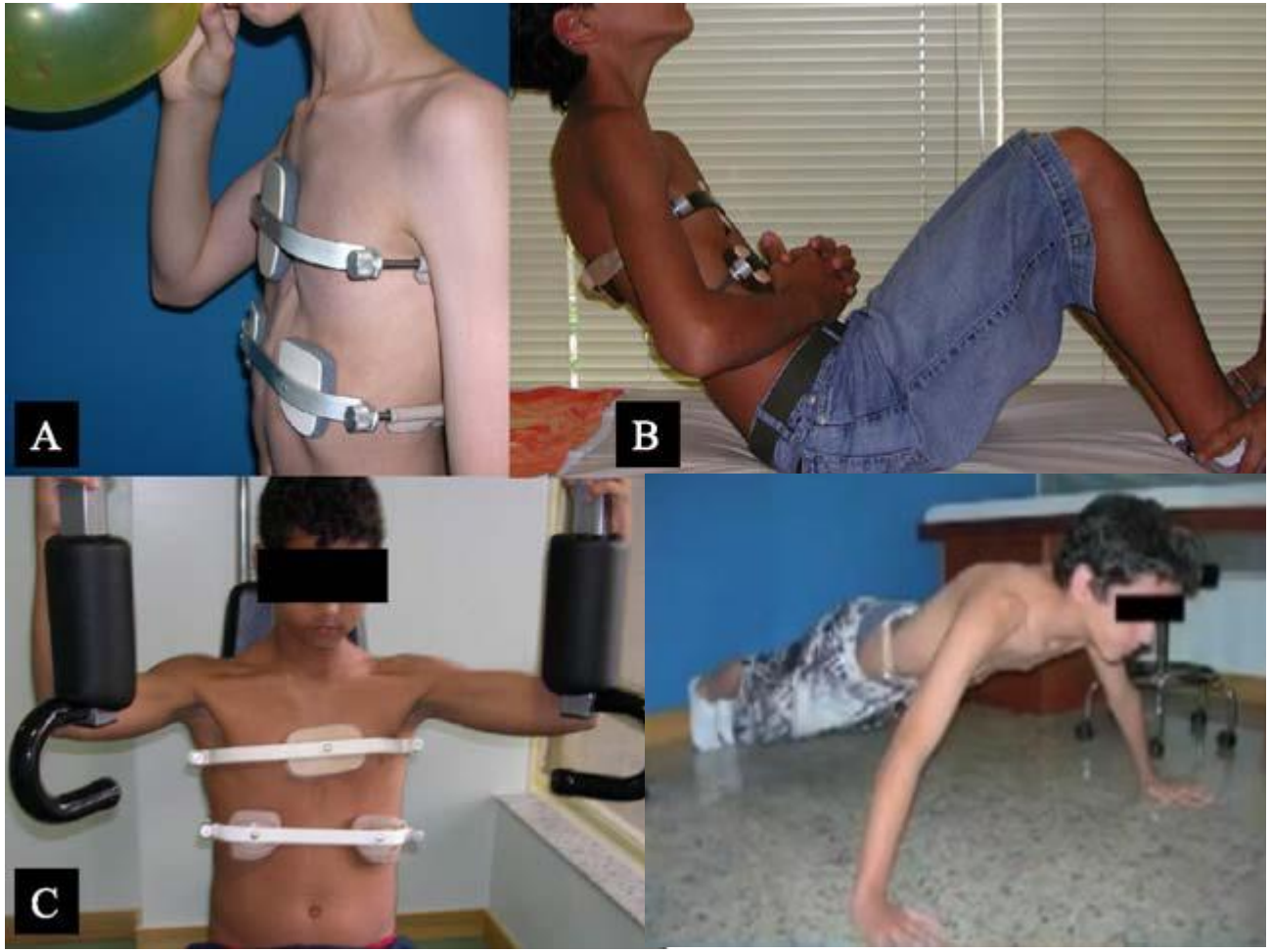


Flared rib



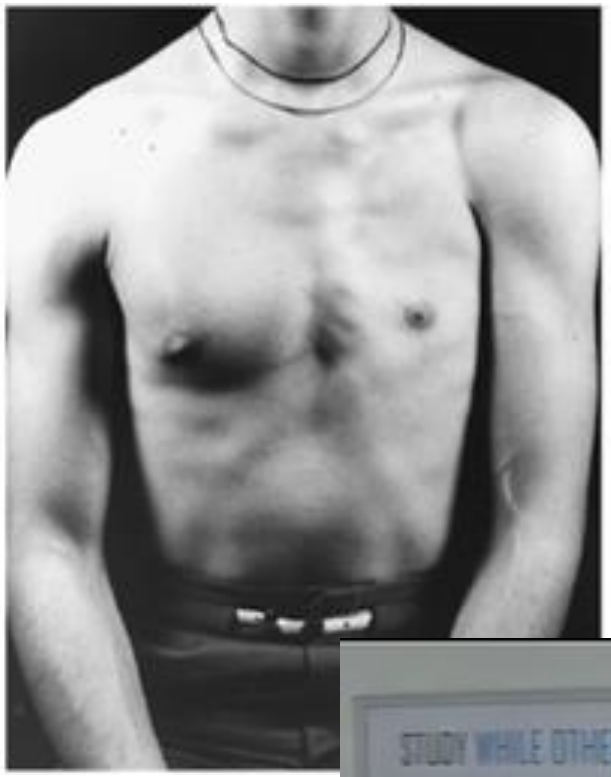
Brace with Excercise



Sydney A Haje, MD – Dynamic Remodeling

Poland's syndrome

- In 1841, while Poland was a medical student, he described congenital absence of the pectoralis major and minor muscles associated with syndactyly
- Incidence of 1 in 30,000 to 32,000
- Associated with
  - Unilateral palsy of the abducens oculi muscle and facial muscles
  - Abnormalities of the hand
    - Syndactyly
    - Hypoplasia of the thumb
    - Hypoplasia or aplasia of the middle phalanges
    - Rarely, complete absence or hypoplasia of the hand and forearm



A

C

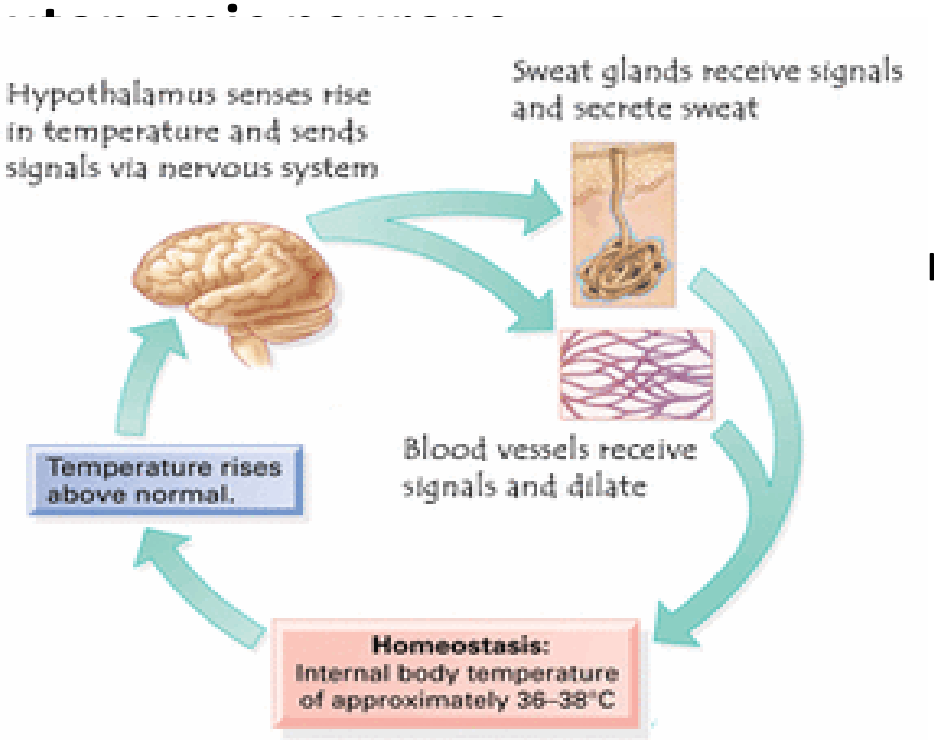
Hyperhidrosis

Hyperhidrosis

- Pathologic condition of *excessive sweating* in amounts *greater than physiologically needed for thermoregulation*

Pathogenesis

- **Eccrine sweat glands are responsible for hyperhidrosis**
  - mixture of the two [apo/eccrine] glands may play a role in axillary hyperhidrosis
- **A sympathetic signal is carried to sweat glands by cholinergic a**
- **Idiopathic (**
  - Sweat glan
  - Abnormal
- **Genetic com**



nally normal.

Types of hyperhidrosis

- **Focal or primary hyperhidrosis**
  - face, palms, soles, or axillae
- **Generalized sweating(secondary)**
  - Excessive heat and obesity
  - Infections, endocrine disorders, neuroendocrine tumors, malignancy, neurologic disorders, toxins, and previous spinal cord injuries
  - Present as adults and have excessive sweating that occurs both while awake and asleep

Treatment

- **Nonsurgical Treatment**

Table 2. Comparison of Therapies for Primary Hyperhidrosis

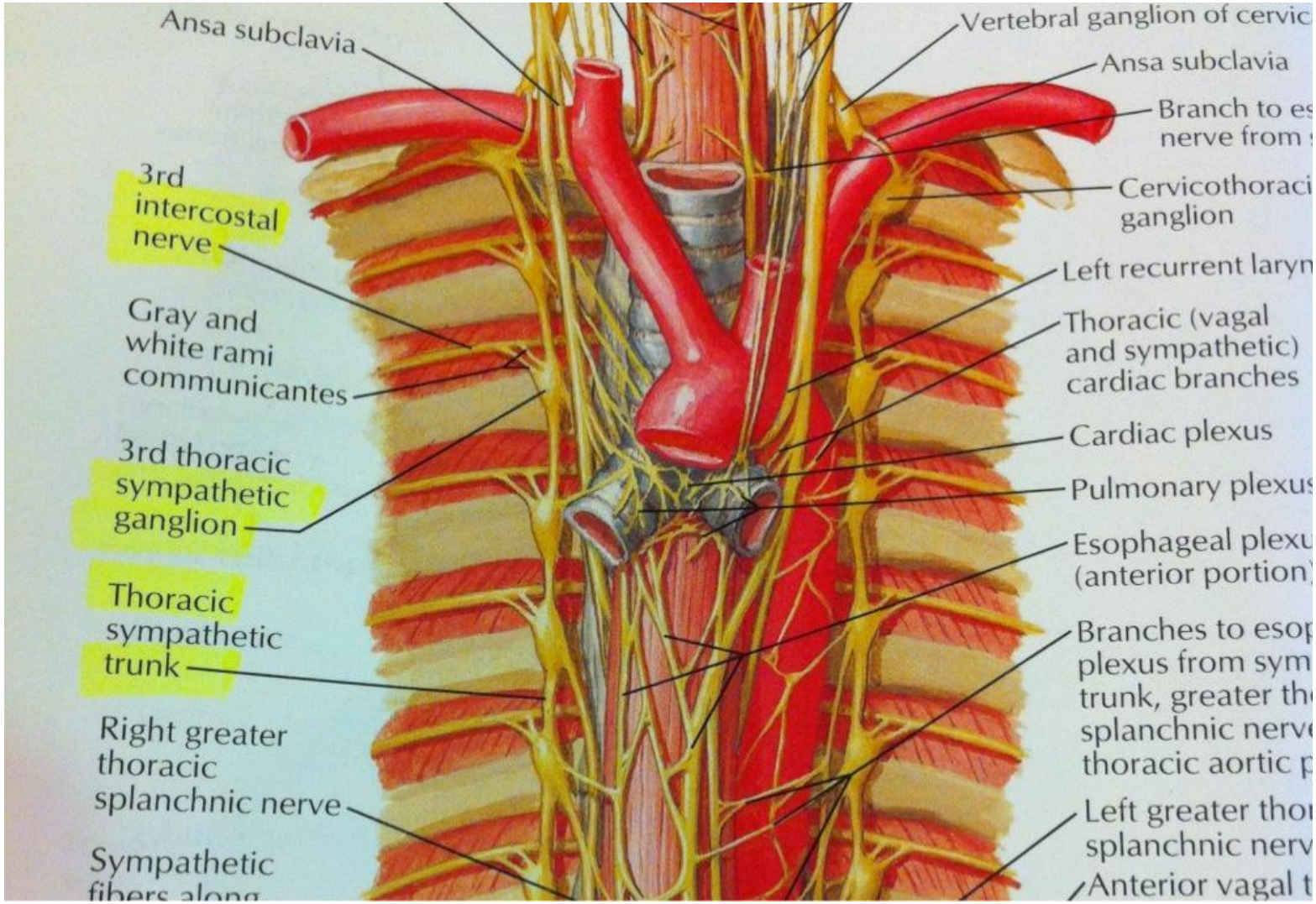
Treatment	Cost[a]	Side Effects
Topical, 20% to 35% aluminum chloride	$288+/year	Skin irritation, localized burning, stinging, desquamation, poor efficacy, temporary (lasts about 48 hours per application)
Iontophoresis (usually 20 mA 3 to 4 treatments a week for 30 to 40 minutes each)	$500/device	Irritation, dryness or peeling of skin, burning or stinging during therapy, temporary (one treatment lasts 1 to 4 weeks). Not recommended for women who are pregnant or for persons with pacemakers or substantial implants (eg, joint replacements)
Oral therapy (glycopyrrolate, atropine, acetylcholine inhibitors)	$240+/year	Dry mouth, dry eyes, constipation, mydriasis, difficulty urinating, blurry vision
Botulinum toxin (Botox A or B)	$2,250/session	Pain from injections, muscle weakness, headache, hematoma, swelling, need for repeat procedures
Liposuction/VASER	$3,000/session	Hematoma, superficial skin erosion, alopecia, paresthesia
Endoscopic thoracic sympathotomy	$15,000	Compensatory hyperhidrosis, bradycardia, pneumothorax, postoperative pain, Horner's syndrome

[a] Approximate cost in US dollars.

Nomenclature for Sympathetic Surgery

- **Rib- oriented nomenclature**
  - Too many patients having mediastinal fat that can obscure clear identification of the specific ganglia
  - Many anatomical variations in the ganglion anatomy
- **Type of interruption**
  - Clipped, cut, or cauterized, or a segment removed
- For example
  - Clipped R5, top
  - cauterized, top R4, bottom R4

Nomenclature for Sympathetic Surgery



Patient Selection

- Surgical consultation should include
  - Secure diagnosis of **primary focal** hyperhidrosis
  - **Anatomic locations** involved
  - **Amount** of hyperhidrosis
  - Full discussion of the options to surgery and potential complications

- The patients should be made aware that the most satisfied patients are those with palmar or palmar-axillary hyperhidrosis, or both.

Location of Interruption of Sympathetic Chain

- **Palmar hyperhidrosis**
  - **R4 alone** interruption(*Yang and colleagues,2007*)
    - Limits the degree of CH
    - May lead to moister hands
  - **R3, R4** interruption
    - Completely dry hands
    - Higher risk of CH
- **Palmar and plantar hyperhidrosis**
  - **R4** interruption
    - Reduce incidence of CH
  - **R4 and R5** intervention
    - Drier feet

Axillary Hyperhidrosis

- ETS for axillary hyperhidrosis
  - often less successful and has higher "regret rates" than ETS for palmar hyperhidrosis.

- **R4 and R5 transection is suggested**
  - Palmar-axillary, palmar-axillary-plantar, or pure axillary hyperhidrosis

- A qualitative review shows a trend of lower incidence of CH with fewer interruptions
  - Incidence of CH *(Munia and colleagues, 2008)*
    - R3/R4 ETS 100% and higher severity
    - R4 ETS alone (42%)
  - Patients who underwent R5 clipping alone experienced no CH, and none regretted having the surgery *(Chou and associates)*

Craniofacial Hyperhidrosis

- R2 vs R3
  - R3: 9% regretted the procedure, and 27% reported CH
  - R2: 16.7% regretted and more than 40% experienced CH

- R2 vs R2+R3
  - significantly higher CH rate in the group that underwent the R2 and R3 transection (95%), as compared with the R2 group (83%)

- **R3-alone interruption is suggested**
  - It reduces the risk of CH and the risk of Horner's when compared with R2 or an R2 and R3 transection

Type of Interruption

- Transection? Resection? Ablatation with a cautery? Division with a harmonic scalpel? or Clipping?
  - No clear differences
    - If the correct level division was achieved
  - Enough separation between the ends of the chain
    - Regrowth is impossible

Complications and Treatment

- Primary side effects of hyperhidrosis surgery
  - **CH, bradycardia, and Horner's syndrome**
    - The higher the level of blockade on the chain, the higher is the expected regret rate

Compensatory Hyperhidrosis

- **The most common side effect**
  - which occurs in the literature from 3% to 98%
- **The most common risk factor**
  - **T2 ganglion interruption(R2, R3)**
  - The number of levels interrupted has been inconclusive as a risk factor
- **Preoperative testing**
  - Injecting bupivicaine
    - reversibly achieve sympathetic nerve blockade observe for CH
- **Treatment**
  - Ditropan or other anticholinergic medications in escalating doses

Horner's syndrome

- **0.7% and 3% after ETS**

- **Addressed in patients with craniofacial hyperhidrosis**
  - Direct injury by cautery, traction, or surrounding inflammation can occur owing to improper localization of the second rib
  - The risk of this complication may be minimized with procedures performed below the second rib (R2)
  - Anatomically, the stellate ganglion can be lower on the left side down to R3

- **Permanent bradycardia**
  - Resting heart rate less than 55 or 50 beats per minute
    - who may require a pacemaker
- **Recurrent hyperhidrosis**
  - Incidence rates vary considerably and have been described as 0% to 65%
- **Others**
  - pneumothorax requiring chest tube drainage (1%)
  - pleural effusion (1%)
  - acute bleeding or delayed hemothorax (1%)
  - Chylothorax
  - persistent intercostal neuralgia (1%)

Thoracic Outlet Syndrome

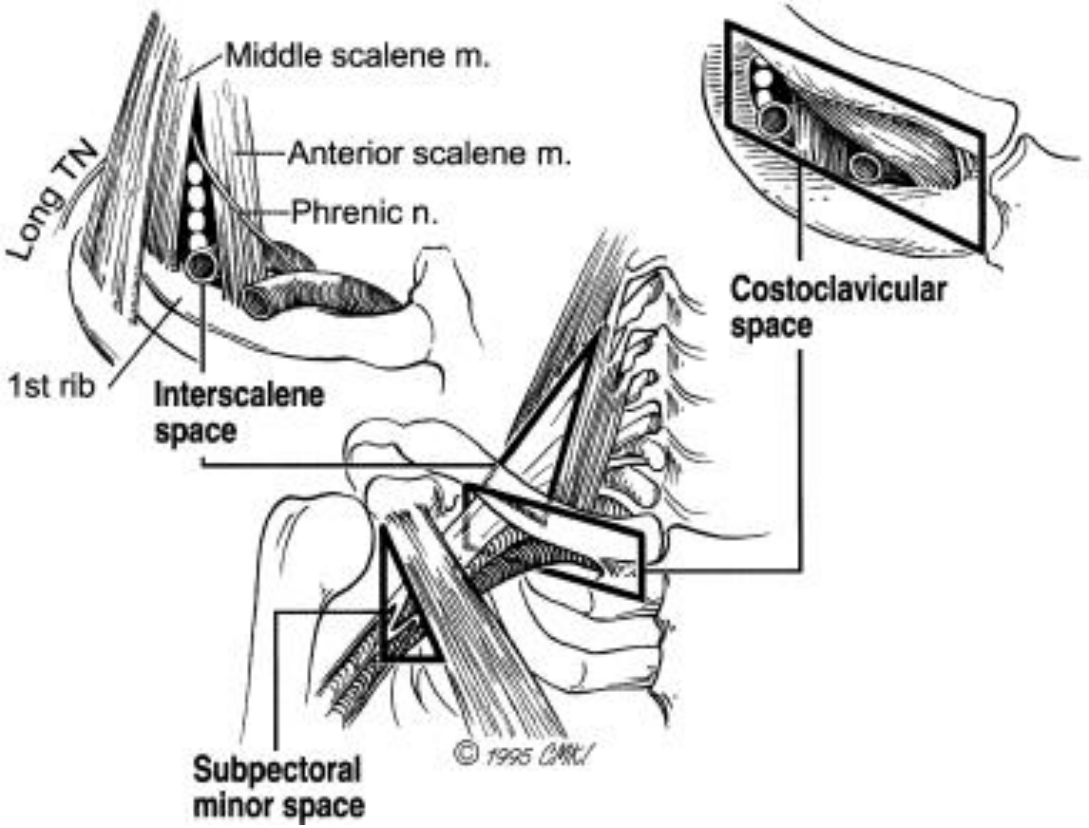
What is TOS

- TOS is a group of anatomically related, conditions caused by compression of neurovascular structures that serve the upper extremity.

Scalene triangle

Costoclavicular space

Pectoralis minor space

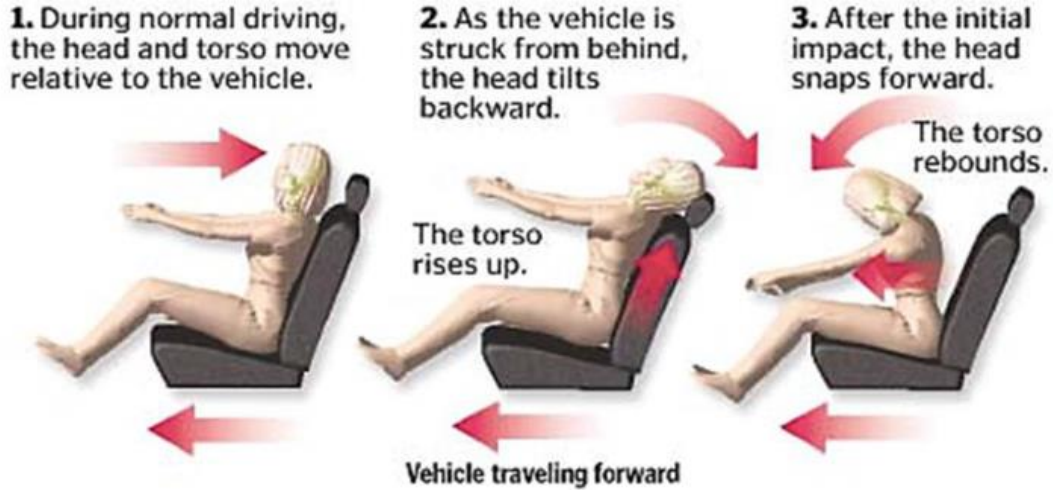


Classification

Type	Characteristics
Neurogenic TOS **85 – 90%**	Caused from **brachial plexus compression** Symptoms include **pain**, **dysesthesia**, **numbness**, **weakness** – **not localized** in specific peripheral nerve distribution
Venous TOS	Caused from **subclavian vein compression** Symptoms include **swelling**, **paresthesias** in the fingers
Arterial TOS	Caused from **subclavian artery compression** Almost always associated with a **cervical rib** or **anomalous rib** Symptoms include **hand ischemia** with **pain**, **pallor**, **paresthesia**, **coldness**

Cause

- Congenital abnormality
  - Cervical rib
  - Prolonged transverse process
  - Muscular abnormality(ant. scalene m., sickle-shaped scalene m.)
  - Fibrous connective tissue anomalies.
- **Trauma**
  - **Whiplash injury**
- **Repetitive strain**
- Etc.
  - Tumor
  - Hyperostosis
  - Osteomyelitis



Evolution of TSO surgery

Table 1 Evolution of thoracic outlet syndrome surgery

Name of operation	Year first performed	Surgeon who introduced it
Cervical rib resection	1861	Coote
First rib resection	1908	Murphy
Scalenotomy	1927	Adson/Coffey
First rib resection – posterior approach	1961	Clagett
First rib resection – supra- and infraclavicular approach	1960s	Various surgeons
First rib resection – transaxillary approach	1966	Roos
Scalenectomy	1938	Adson
Refined scalenectomy	1979	Sanders
Combined approach (transaxillary first rib resection followed immediately by transcervical anterior and middle scalenectomy)	1989	Atasoy

(Adson and Coffey 1927; Atasoy 1996, 2004b)

TOS Surgery Cases

- Barnes-Jewish Hospital : 285 cases/2014
- USA : about 2000 cases annually
- More than 100 cases : 5 institutes in USA

Neglected
333 cases ?

- In KOREA
- Thoracic Surgery data registry
- 4.2 cases annually for 5 years

Message

TOS surgery is one of thoracic surgeon’s area.

Thank you for your attention!